METHOD, DEVICE AND SYSTEM FOR ADJUSTING
MOBILITY MANAGEMENT

5 FIELD OF THE INVENTION

The present invention relates to a method for adjusting
mobility management (MM) settings in a mobile communication
network, e.g. a cellular mobile communication network, and
10 in particular to a method for optimizing the MM settings
for a machine to machine (M2M) application in a mobile
communication network. The present invention is also
related to a corresponding mobility control unit, a
communication unit and/or a corresponding system.

15

BACKGROUND OF THE INVENTION

In the last years mobile communication became more and more
popular. New developments in this field of
20 telecommunication open up an ever increasing number of new
application areas.

One of these new application areas is a M2M application.
M2M stands for machine-to-machine, mobile-to-machine and/or
25 machine-to-mobile communication. The purpose is to enable
controlling procedures, monitoring procedures, parameter
setting procedures, transaction procedures and the like
with machines such as vending machines, elevators, pumps
and meters and the like via a mobile communication system.
30 In other words, communication connections between systems,
devices and individuals are to be established. This can be
done, for example, via the Internet with which mobile
communication networks can already establish connections
and perform data transmission. As wireless access methods
35 can be used, for example, CSD (Circuit Switched Data),

- 2 -

HSCSD (High Speed Circuit Switched Data), GPRS (General
Packet Radio Service), USSD (Unstructured Supplementary
Services Data) and SMS (Short Message Service), which are
all commonly known to a person skilled in the art and for
5   which a detailed description is omitted. M2M applications
can be employed in different types of carrier devices which
are placed on mobile or static platforms, for example
static vending machines or mobile devices in cars, or the
like.
10

When a wireless connection for a communication unit of the
M2M application is used, as for example a mobile
communication connection, the M2M communication unit is
treated like any other common mobile station (mobile
15   phone). This means that all procedures to be executed in
order to establish a connection between the M2M
communication unit and the mobile communication network are
done as usual, such as call control, mobility management
(abbreviated hereinafter as MM), and the like.
20

Commonly agreed standards for MM, e.g. in a GPRS
environment, are disclosed, for example in 3GPP (3rd
Generation Partnership Project) specifications TS 24.008
V3.9.0 (2001-09) and TS 23.060 V3.9.0 (2001-10). In these
25   specifications, among others, in particular MM processing
and the adjustments of MM timers (ready timer, periodic
routing area (RA) update timer, mobile reachable timer) in
mobile stations and network control nodes such as SGSN
(serving GPRS support node) are described as they are
30   usually to be performed. The terms standby state, ready
state, ready timer, periodic location area update, periodic
RA update, location area (LA) update, periodic RA update
timer, cell update, mobile reachable timer, which are
commonly known by a person skilled in the art, are for
35   example defined in these referred 3GPP specifications TS

- 3 -

24.008 V3.9.0 (2001-09) and TS 23.060 V3.9.0 (2001-10). A particular example of MM procedure is how long is an mobile station maintained in ready mode (2G GPRS) and how often a periodic update (e.g. periodic Routing Area (RA) update in GPRS) is performed.

Currently MM timers are optimized based on average behavior of a Mobile station (MS), i.e. MS mobility (affecting e.g. number of RA update; number of cell updates; probability to move out of coverage) and MS traffic pattern (affecting e.g. probability to be paged). In addition, MM timers takes into account various other factors such as a RA size (affecting e.g. number of RA update and paging load) and quality of coverage (affecting e.g. probability to move out of coverage).

For better understanding, a short description of present mobility management in different mobile communication systems, e.g. in a mobile switching center (MSC), second generation serving GPRS support node (2G SGSN), 3G SGSN, and relevant differences thereof is given. These, however, are known to persons skilled in the art.

A 2G SGSN tracks the location of an MS at a cell level in ready mode, and in RA level in stand-by mode. The MS and network stay in ready mode for the duration of the ready timer after the last uplink transmission. After that both change to stand-by mode where RA Update are made when RA change or periodic RA Update timer expires. In order to prevent fast moving MS to stay always in ready mode (as they always make cell update before ready timer expiry), the SGSN may force the MS to move to stand-by after a routing area update procedure. The ready timer and periodic RAU timer values are indicated to the MS in the attach accept or RA Update accept message.

A 3G SGSN tracks the location of an MS at radio network
controller (RNC) level in MM-Connected mode, and in RA
level in MM-IDLE mode. RNC tracks the user at cell or URA
5   (UTRAN (UMTS Terrestrial Radio Access Network) Registration
Area) level. The RNC has a mobility management (sometimes
referred as location management) mechanism very similar to
the MM mechanism described above as it also has periodic
cell or URA update procedure. The periodic timer (value)
10   applicable is broadcasted in the area. The MS and network
stay in MM-Connected mode until this one is explicitly
released. A corresponding release request may be initiated
from the RNC (e.g. triggered by an inactivity timer or
triggered by detecting the maximum number of URA update
15   without data transmission) or from the SGSN (e.g. by moving
back the MS to MM-Idle state after completion of a RA
update procedure). In the MM-Idle mode, RA updates are made
when the RA changes or when the periodic RA update timer
expires.
20

The ready timer and periodic RA update timer values are
indicated to the MS in the attach accept or RA update
accept message for both 2G and 3G. It is to be noted that
this ready timer value is sent also in 3G protocols (due to
25   the desired interoperability with 2G) although 3G does not
comprise a ready state.

An MSC (2G or 3G) tracks the location of an MS at RNC or
base station controller (BSC) level in MM-Connected mode
30   (i.e. during a call), and in LA level in MM-IDLE mode. The
MS and network stay in MM-Connected mode until this one is
explicitly released. The release request may be initiated
from the RNC (e.g. due to a loss of coverage during the
call) or from the MSC (e.g. due to an end of the call). In
35   MM-Idle mode, location updates are made when the LA changes
or a periodic Location Update timer expires. The periodic

ART 34 AMDT

Location Update timer value is currently indicated to the MS
in the broadcast information (thus, all MS in same location
area use the same value).

5   However, when a large number of additional communication
units for M2M applications are introduced in the existing
mobile communication network structures this will result in
an increase in the signaling load for the networks.

10   In document WO 00 38469 A an apparatus and a method for
providing page messages to mobile radios based on the
mobility rates of the mobile radio are described. For mobile
radios that are relatively stationary, page messages are sent
to a cell in which the mobile radio resides, while radios
15   which are increasingly mobile receive their page messages on
a local area basis. The mobile radio only performs location
updates when the situation is optimized for doing so
depending upon the mobility of the radio, the introduction of
a new cell, the introduction of a new location area, the
20   expiration of a pre-determined time limit and the status of a
new cell location flag. A function is defined for location
updating on either a locationary basis or a cell basis in
accordance with each of the above factors in order to
optimize the burden of location area updating and unwanted
25   page broadcasting.

In document WO 99 52306 A a method in the packet switched
data transmission between a wireless communication device and
a packet network is described, in which data transmission
30   between the wireless communication device and the packet
network is controlled with at least one packet switching
controller (SGSN). A group of connection states is defined in
the method, from said connection states one is selected at a
given time, and the selected connection state is set to the
35   wireless communication device and to the packet switching
controller. In addition, said connection states are defined
in the method to be: a ready state, in which packets are

transmissable in an activated data transmission connection, a
standby state, in which data transmission connection packets
to be transmitted and received are waited for, and an idle
state, in which the data transmission connection is
5 deactivated. As a connection state also an extended ready
state is defined, to which a transition from the ready state
is conducted, and in which data transmission connection
packets to be transmitted or received are waited for.

10 In "Location management strategies for mobile cellular
networks of 3rd generation" by D. Plassmann, Vehicular Techn.
Conf., 1994, IEEE 44th Stockholm, Sweden, 8.10 June 1994, New
York, NY, USA, IEEE, 8 June 1994, pages 649-653, XP010123353
ISBN:0-7803-1927-3, several location management strategies
15 applicable in cellular networks are described. Analytical
modelling approaches for signalling cost minimisation are
discussed. Results of a GSM based case study are given which
are applicable to cellular radio systems of the 3rd
generation like MBS and UMTS. A hybrid dynamic strategy is
20 proposed for a public MBS.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an
25 improved method of adjusting the mobility management in a
mobile communication network, and to provide a corresponding
system and/or units which improve the mobility management
adjustment in the mobile communication network.

30 This object is achieved, for example, by a method of
adjusting mobility management according to claim 1.

Furthermore, this object is achieved, for example, by a
mobility control unit according to claim 15.
35
Additionally, this object is achieved, for example, by a
communication unit according to claim 29.

Furthermore this object is achieved, for example, by a
mobility management adjustment system according to claim 34.

Advantageous further developments of the present invention
5 are as set out in the respective dependent claims.

The mobility information related to said communication unit
may include a specific information element indicating a
periodic update timer value and/or predefined mobility
10 management parameter for mobility management elements of said
communication unit and/or said mobility control unit, said
periodic update timer value and/or predefined mobility
management parameter being detected in said evaluating step.

15 Furthermore, said mobility information related to said
communication unit may include previous location information
and current location information of said communication unit,
said previous location information and current location
information being compared in said evaluating step to
20 determine whether they are equal.

In the adjustment, said timer elements (or mobility
management elements) of said communication unit and/or said
mobility control unit may be set to predefined changed
25 periodic update timer values and/or predefined changed
mobility management parameters.

Furthermore a function of the mobile communication network,
which is used to force a modification of an operation state
30 of the communication unit, may be disabled during the MM
adjustment.

The communication unit may be employed in a static device
used for a M2M application, such as a vending machine. This
35 means that the communication unit represents an "immobile
mobile station".

The mobility control unit may be integrated in a core network
control unit of the mobile communication network. The present
invention can be employed in different types of mobile
communication networks, such as circuit switched or packet

5 switched networks, 2nd or 3rd Generation communication
networks (GSM, UMTS) and the like. Thus, the core network
control unit may be, for example, a mobile switching center
(MSC) or a SGSN. However, also other network control elements
controlling the MM can be employed.

10

The timer elements (or mobility management elements) may be
timer elements of said communication unit and said mobility
control unit, e.g. ready timers, periodic routing area update
(RAU) timers or periodic LU timer of said communication unit

15 and/or said mobility control unit (e.g. core network control
unit).

The mobility information related to said communication unit
may be provided from said communication unit. Furthermore,

20 the mobility information related to said communication unit
may be provided from a core network control unit of the
mobile communication network.

The mobility information may include a request for setting at

25 least one timer element (or mobility management element) to a
maximum value or a request for deactivating at least one
mobility management element. Correspondingly, the timer
elements (or mobility management elements) may be set to
maximum setable values and/or may be deactivated.

30 Alternatively, the timer elements (or mobility management
elements) may be set to values which are incremented by a
predetermined amount in comparison to the values set before.

By using the present invention it is possible to optimize
mobile communication system settings with regard to
parameters like location accuracy level, timer threshold
5   values and the like used for MM. In other words, it is
possible to advantageously decrease signaling load with
regard to the MM processing in mobile communication
networks in comparison to the generic MM processing. In
particular in cases in which a M2M communication unit is,
10   for example, a static device, it is possible to reduce MM
signaling significantly by means of adjusting, for example,
the ready timer and the periodic routing area update timer
of the communication unit as well as the ready timer in the
core network control unit to predefined changed values,
15   e.g. to maximum values. The adjustment is preferably
initiated by a mobility control unit, e.g. integrated in a
core network control unit, which is adapted to identify a
mobility information related to the M2M communication unit
to be controlled. If this specific mobility information
20   element is identified, the improved MM adjustment
processing is executed after which periodic updates are
made as rarely as possible, and e.g. in a 2G GPRS system,
the communication unit is maintained in the ready state for
a long time. When the M2M communication unit maintained in
25   the ready mode is a static device, no increase of signaling
load by cell update requests will result. However, a
signaling load due to paging (when the communication unit
is to be reached) is significantly reduced. Since the
communication unit is held in the ready state for a long
30   time, the need for paging is reduced. Furthermore, since
also e.g. the periodic routing area update timer is set to
the maximum value and the long duration of the ready timer
delays periodic RA update requests, also the signaling load
due to periodic RA update is reduced.

35

- 10 -

Preferred embodiments of the invention are described herein below in detail by way of example with reference to the accompanying drawings.

5   BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a part of a mobile communication network for illustrating a MM adjustment procedure,

10   Fig. 2 is a flow chart illustrating a MM adjustment procedure,
Fig. 3 shows a part of a mobile communication network for illustrating a MM adjustment procedure,

15   Fig. 4 is a flow chart illustrating a MM adjustment procedure,

Fig. 5 is a diagram illustrating a signaling connection in the mobile communication network of Fig. 3,

20

Fig. 6 is a flow chart illustrating an adaptive MM adjustment procedure,

Fig. 7 is a flow chart illustrating an adaptive MM
25   adjustment procedure, and

Fig. 8 shows a part of a mobile communication network for illustrating a MM adjustment procedure.

30   DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figs. 1 and 2, the concept of the MM adjustment is described. According to Fig. 1, a M2M communication unit 1 is (wireless) connected with a mobile
35   communication system 3. Via this wireless connection,

signaling and traffic data communications are sent and
received by the M2M communication unit. The control of this
communications is placed in respective network elements
(not shown) of the mobile communication network 3, as

5   commonly known. Furthermore, a mobility control unit 4 is
provided which is used to execute the MM adjustment. For
this purpose, mobility information is received by the
mobility control unit 4 (step S1 in Fig. 2). This mobility
information are evaluated in the mobility control unit 4 in

10   order to detect a degree of mobility of the respective M2M
communication unit 1 (step S2 in Fig. 2). On the basis of
this evaluated degree of mobility, the mobility control
unit 4 is adapted to initiate an adjustment of the MM
processing in the communication network for the M2M

15   communication unit 1 (step S3 in Fig 2). This will also be
described later.

The mobility control unit 4 can be located at different
places in the mobile communication network. It may be

20   integrated, for example, in a core network control unit
executing the MM processing, e.g. in a 2G SGSN, 3G SGSN,
MSC and the like (i.e. the respective core network element
is also the mobility control unit). However, it may be also
implemented in a network element outside the core network

25   structure, for example at a RNC of a 3G mobile
communication network.

The mobility information may comprise different contents.
For example, specific values for mobility management timers

30   (ready timer, periodic RA update timers and the like), an
explicit parameter used as an indication of mobility for
the M2M communication unit, information concerning the
historical behavior of M2M communication unit (no movement
within the coverage area of the cellular mobile

35   communication unit, or the like) can be used by the

- 12 -

mobility control unit for the evaluation of the degree of
mobility.

5
The mobility information can be sent from respective
different sources in the mobile communication network. One
source can be, for example, the M2M communication unit 1
itself, preferably in cases of mobility information
contents like a specific value for mobility management
timers or an explicit parameter used as an indication of

10
mobility. However, it is also possible that the source for
the mobility information is another network element, for
example a core network element as a SGSN, for example in a
case of mobility information contents like the historical
behavior of M2M communication unit. Nevertheless, such

15
historical behavior information contents can be provided
also by the M2M communication unit 1.

The adjustment of the MM by the mobility control in the
mobile communication network may comprise a change of

20
setting of mobility management elements of the
communication unit 1 and/or of the mobility control unit 4
(e.g. of a SGSN or the like). The mobility management
elements are, for example, timers (ready timer, periodic RA
update timer) whose values are changed. It is also possible

25
to increment these values step by step. This means, the
mobility management elements (timers) are set to predefined
changed values which are for example stored in the mobility
control unit.

30
Further embodiments and modifications thereof of the MM
adjustment are described hereinafter for different
applications. For the sake of simplicity only parts of the
overall mobile communication networks are shown in order to
show up the measures to reach the improved MM processing.

- 13 -

However, as commonly known, mobile communication networks may comprise several other elements.

Fig. 3 shows a block diagram of a mobile communication
5   network 30 in which the improved MM processing is implemented. According to Fig. 3, a 2nd generation GPRS communication network is described. However, it is easy to understand that also other mobile communication networks can be used (3rd generation, CSD, and the like).

10

In Fig. 3, reference sign 10 denotes M2M communication units. A M2M communication unit 10 represents preferably a static device such as a vending machine or the like. The M2M communication unit 10 is adapted to communicate with
15   the mobile communication network, for example via a packet switched GPRS communication connection, in order to exchange data (control and/or traffic data).

Reference sign 20 denotes a base station subsystem of the
20   mobile communication network. The base station subsystem 20 is connected with the communication units 10, for example, via air interfaces (shown by dotted lines). The base station subsystem 20 is adapted to establish a connection between the communication units 10 and the remaining mobile
25   communication network elements by forwarding signaling and traffic data through corresponding channels or connections to and from the communication units 10.

Reference sign 40 denotes a SGSN as a core network control
30   unit. The core network control unit is adapted to control the elements of the mobile communication network and to perform control procedures for communication connections in the mobile communication network. In particular, the core network control unit is adapted to execute the call control
35   (MSC) or Session Management (SGSN) and MM procedures for

- 14 -

the communication units 10 connected to the mobile
communication network 30. This means that the core network
control unit 40 determines parameters used for the MM such
as timer values and initiates the settings or the
adjustment thereof. Moreover, the core network control unit
is adapted to establish connections to other networks, e.g.
via gateways (not shown), and to other communication units
connected to the mobile communication network, e.g. via
base station subsystems. According to this embodiment, the
SGSN 40 is provided with a mobility control unit adapted to
execute a MM adjustment.

As shown in Fig. 4, MM timers are connected with the M2M
communication unit 10 and the SGSN 40. Ready timers 15, 45
define the time period in which the M2M communication unit
remains in the ready state. A periodic RA update timer 16
is used to control a procedure in the M2M communication
unit 10 to periodically notify the availability of the M2M
communication unit 10 to the mobile communication network.
This means, the periodic RA update timer 16 is used to
detect when an MS lose coverage. A mobile reachable timer
46 is used to monitor the periodic RA update procedure in
the SGSN.

With reference to Figs. 4 and 5, the improved MM procedure
being performed in the MM adjustment in the mobile
communication network described above is illustrated.

In the MM adjustment procedure according to the embodiment,
first, the M2M communication unit 10, for example a vending
machine, sends a registration message via the base station
system 20 to a SGSN 40 representing the core network
control unit of the mobile communication network 30 (step
S20 in Fig. 4; message M1 in Fig. 5). Usable registration
messages are, for example, an attach request or a RA update

- 15 -

request from said M2M communication unit 10. Said
registration message M1 further comprises a specific
mobility information element adapted to indicate the degree
of mobility (or immobility) of the requesting M2M

5   communication unit 10. In other words, said specific
mobility information is used to indicate the core network,
at least implicitly, that the M2M communication unit is
likely not to move within the area of the mobile
communication network. Hence, it indicates that, e.g., a RA

10 update procedure will probably not occur. According to a
first example, said specific information element is a
request to set MM timer(s) (e.g. ready timer 15, 45, and
periodic RA update timer 16) to a specific value, namely to
the maximum setable value. It is proposed to use for 2G and

15 3G GPRS, the requested READY timer value. In the case of
presently used mobile communication networks this value may
be a little time over three hours.

The SGSN 40 receives the registration request M1 comprising
20 the specific mobility information and identifies the
specific mobility information as an indication of the
degree of mobility of the requesting M2M communication unit
10 (step S30 in Fig. 5). For this purpose, the SGSN 40 may
comprise a specific device (not shown), e.g. a software

25 component, which is adapted to perform the identification
and to initiate the improved MM processing. This is
preferably performed in the mobility control unit, e.g. by
using a pre-stored value for a comparison, or the like.

30 In the identification process (step S40 in Fig. 4), the
SGSN 40 determines whether the specific mobility
information comprises an acceptable value indicating the
immobility of the M2M communication unit 10, e.g. the
request for the maximum value of the MM timers. If this

35 acceptable value is not recognized, i.e. when no indication

- 16 -

of immobility can be recognized, a generic MM processing
with normal timer adjustment may be performed (step S50 in
Fig. 4). It is to be noted that interoperability is
maintained with node not implementing this identification
5   process, as they will always use normal timer adjustment.

Otherwise, when the SGSN 40 determines in step S40 that the
specific information element comprises an acceptable value,
i.e. it identifies the immobility of the requesting M2M
10   communication unit 10, another MM processing will be
performed. In this case, predefined changed values for the
MM timers will be determined (step S60 in Fig. 4) by the
SGSN 40, for example by means of the mobility control unit,
on the basis of the specific information element. For
15   example, the specific mobility information itself may be
used as the value for the MM timer setting when the
specific information element comprises the maximum value
for the MM timers (e.g. the maximum value of the ready
timers 15, 45). Also a table or the like stored in the SGSN
20   40 can be used in which the values for the MM timers
related to the specific mobility information are stored.
Additionally, also values for MM timers other than the
ready timers 15, 45, e.g. the periodic RA update timer 16,
are determined to become maximum values (in case of
25   recently used mobile communication units, the maximum value
for periodic RA update timer may be some time over three
hours).

When the ready timers 15, 45 and the periodic RA update
30   timer 16 are to be adjusted to the maximum values,
according to the predefined changed values determined in
step S60, the SGSN 40 adjust the ready timer 45 connected
with the SGSN 40 to the determined maximum value.
Furthermore, the SGSN 40 transmits the determined MM timer
35   setting values to the requesting M2M communication unit 10

- 17 -

in connection with an acceptance message M2 (Fig. 5) for the registration request M1 (step S70 in Fig. 4), i.e. an attach accept message or a RA update accept message. The determined MM timer setting values in the message M2

5   comprises the maximum values for the ready timer 15 and the periodic RA update timer 16. These maximum values are used by the M2M communication unit 10 to adjust the MM timers in the M2M communication unit 10 such that the maximum time period is achieved for both MM timers (step S80 in Fig. 4).

10 In parallel, the SGSN 40 has adjusted its MM timer(s) (i.e. the ready timer 45 and its mobile reachable timer 46) to the maximum value, wherein in practice a small time delay is to be considered due to the transmission time required so as to ensure that both ready timers 15, 45 match.

15 Thereafter, the MM processing is ended (step S90 in Fig. 4).

Preferably, the SGSN 40 is controlled in such way that a "Forced to standby" procedure, which is usually performed

20 in the generic MM processing to force a mobile station to enter from the ready mode into a standby mode, is not performed in answering periodic RA update from such a M2M communication unit 10. For this purpose, for example, an indication that the M2M communication unit 10 is immobile

25 is stored in a memory (not shown) to which the SGSN 40 refers to when a "Forced to standby" processing is to be executed. This storing may be performed for example in connection with step S70. When this indication for the respective M2M communication unit can be found in said

30 memory, the "Forced to standby" processing will be disabled.

Preferred values for the setting of the ready timer and the periodic RA update timer are presently, for example, a

35 little bit over 3 hours, respectively. Thus, the overall

time (i.e. time of ready timer + time of periodic RA update
timer) is somewhat over 6 hours. Hence, routing area update
is performed as rarely as possible, which is to be
preferred as the M2M communication unit is not moving.

5   Hence, MM signaling load can be reduced by the improved MM
adjustment in comparison to generic MM procedure. For
example, in comparison to the generic MM in which for a
communication unit (also for a static one) the ready timer
is set to 36 seconds and periodic RA update timer is set to

10   3 hours, the load generated by the static M2M communication
unit adjusted with the values as described is divided by 2.
For a M2M communication unit for which the ready timer is
set to 36 seconds and periodic RA update timer is set to 30
minutes, the load generated is divided even by 12.

15

Additionally, the paging load is reduced in the mobile
communication network as the communication unit 10 remains
a long time in the ready state, due to the high value for
the ready timer, and the SGSN 40 is aware of that fact.

20

Alternatively to the above described embodiment, it is also
possible that the M2M communication unit 10 requests,
instead a specific value for the ready timer, a value
indicating a deactivation of the ready timer.

25

In such case there are at least two possible ways for the
SGSN 40 to react. Which one of these is to be selected may
depend, for example, on operator's presettings of the SGSN
40.

30

First possibility is that the SGSN 40 accepts this value,
i.e. the deactivation of the ready timer. A corresponding
setting for the MM timers will then be transmitted to the
M2M communication unit 10 (equivalent to step S70 in Fig.

35   4) which is processed by the M2M communication unit 10 to

deactivate the ready timer 16. A corresponding processing
is performed by the SGSN 40 with regard to the ready timer
45.

5   This means, that the SGSN stores the requesting M2M
communication unit to be always in the ready mode. A
possible loss of coverage (e.g. by physical destruction or
battery expiration) will not be detected by the cellular
mobile system. However, routing RA update signaling is

10 completely suppressed, i.e. the MM signaling load is
further reduced.

The second possibility is that the SGSN does not accept
this value as it would suspend mobile reachable timer 46

15 which is the only way to detect that an M2M communication
unit is not present anymore. In this case, the SGSN 40 (or
the mobility management adjustment device comprised
therein) may proceed as described in the first embodiment,
i.e. adjusting the MM timers to the maximum value (steps

20 S40, S60 to S90 of Fig. 4).

It should be noted that a benefit of this previous
embodiment is that this MM adjustment can be existing with
the requested READY timer value which are already part of

25 the protocol for 2G and 3G GPRS (see, e.g., 3GPP 24.008).
It is to be noted that this ready timer may be sent also in
3G protocols (due to interoperability with 2G even is 3G
does not have a ready state), and so this timer (value) may
also be used to indicate the degree of mobility in a 3G

30 system.

A second embodiment is that the MS (i.e. the M2M
communication unit) reports its mobility to the network
(i.e. to the mobility control unit) with a new explicit

35 parameter. The following description is applicable to

- 20 -

mobile connected to a MSC. However, the same ideas apply also to other system such as GPRS.

A first option is to indicate the mobility through an explicit mobility management parameter "mobility indication". A first simple solution is to indicate only 2 values (static or normal) for this parameter. This value is then configured in the MS and detected in the mobility control unit. A second alternative is that this parameter contain a more complex mobility value (e.g. on a scale from 1 to 10, 1 being static, and 10 fast moving). This value is derived in a standard way by the MS. For example, the MS use the number of cell changes in the last hours (up to a few days). Preferably exponential weight should be applied to give more weight to recent cell changes than to old one. And the resulting value should be mapped to the proposed scale. It should be noted that MS is always aware of cell changes as it has to select on which cell to camp. This mobility indication is included as a new optional information element in the location updating request (used also to attach to the MSC). In the location updating accept message, the MSC includes a new parameter "periodic Location Update timer value". If the MS receives this parameter, it shall use this value instead of the value broadcast on the system information. This kind of MM adjustment requires changes to specifications, but such a mechanism can be introduced without backward compatibility problems. Only MS (e.g. M2M communication units) supporting this feature may send in the request the new parameter "mobility indication", so only MS supporting this feature may receive in response the new parameter "periodic Location Update timer value". If the MS support this feature, but not the MSC, the MSC will ignore this unknown optional parameter ("mobility indication"), and so it will not return any "periodic Location Update timer value". The

MS will then use the normal value as broadcast on system
information.

A third embodiment is an "adaptive Mobility Management"
which is described also with reference to Figs. 6 and 7.
According to this embodiment, a core network node with a
mobility control unit adapted to execute such an "adaptive
MM" is used in the mobile communication network. The
concept of adaptive mobility management is that the core
network (e.g. by means of the mobility control unit)
monitors the degree of mobility of the MS without support
of the MS (i.e. without an indication from the MS), and
adapt its MM behavior (especially MM elements such as MM
timers) based on the detected degree of mobility. This
third preferred implementation is described in more details
for a 2G SGSN used by GPRS system connected to a GSM radio
network (such as shown in Fig. 3). The 2G SGSN comprises a
default periodic RA update timer value which is indicated
to the MS after an attach or a non-periodic RA update. This
means, as shown in Fig. 6, when a RA update request is
received by the SGSN, it is checked whether this is a
periodic RA update (steps S100, S110). When the RA update
is identified to be not a periodic RA update, generic MM
timer settings (i.e. for example default periodic RA update
timer value) is used for the MM adjustment (step S120).
However when a periodic RA update is identified, step S130
is executed. This means, after a periodic RA update
(indicating that the MS did not change RA during the time
of the previous periodic RA update procedure), the new
periodic RA Update timer is equal to the old one (as
indicated in the periodic RA update request) increased by
e.g. 10%. With this solution, a static MS (e.g. M2M device)
will quickly (in a few days) reach its maximum periodic RA
update timer value, minimizing the number of RA update load
to the system.

Similarly, as for example shown in Fig. 7, in this "adaptive MM", the ready timer is negotiated during the RA update and attach procedure. It is proposed that the 2G
5   SGSN implements a "change of cell" flag, which will be set to TRUE if the cell (i.e the location of the MS) is changing between RA update procedures. This requires the SGSN to always store the last known cell ID (even in Stand-by state) to be able to compare the new cell with the last
10   known one. After a RA Update procedure is completed the flag is set to FALSE. The proposal is that before sending the RA Update accept, the SGSN checks the value of this flag. If this value is still false, it means that the MS has not changed cell since the previous RA Update, and then
15   the new ready timer indicated to the MS is the old one increased by e.g. 10%. If the value is set to TRUE, the normal ready timer value (same than after first attach) is returned. In detail, as depicted in Fig. 7, in step S150 it is checked in the SGSN whether there is a cell change. If
20   NO, step S170, the "change of cell" flag is set to false. If YES, step S160, the "change of cell" flag is set to true. When a RA update procedure (e.g. periodic RA update) is executed (step S180) the SGSN checks whether the "change of cell" flag is set to false (steps S190, S195). (It is
25   clear that similarly also a check whether the flag is set to be true may be performed). When the flag is not false (i.e. true), the default ready timer value is used for the MM adjustment (step S220). If the flag is false, in step S200, the indicated ready timer value is incremented (e.g.
30   by 10%), and the incremented ready timer value is used for the MM adjustment (step S210). When the RA update procedure is completed (step S230), the "change of cell" flag in the SGSN is reset to be false (step S240). Then, the process is repeated.

35

- 23 -

With this solution, a static MS (e.g. M2M device) will quickly (a few days) reach its maximum ready timer value, minimizing the number of paging and RA Update load (because periodic RA Update timer is started only after expiry of
5   the ready timer) in the system.

It should be noted that according to the third embodiment, the timer values themselves (as normally indicated) are used as an indication of the MS mobility. It would be
10 possible to also use a separate indicator as described above. When the ready timer reaches a high enough value (e.g. one hour), this may be considered as an indication that the MS is very static. Therefore 2G SGSN should disable the forced to stand-by mechanism based on this
15 indication.

A fourth embodiment is shown, for example, in Fig. 8. According to the fourth embodiment, an implementation of the MM adjustment in a 3G mobile communication system 330
20 comprising, among others, a MS (M2M communication unit) 310, a RNC 320, in which a mobility control unit is integrated, and core network elements including a SGSN 340 is shown. The RNC 320 (with the mobility control unit) is adapted to modify the periodic (cell or URA) update timer
25 value based on an indication of the degree of the mobility of a MS, i.e. of a M2M communication unit 310. This indication may be sent by the MS 310 in a RRC (radio resource control) message (similar to the mobility indication in the second embodiment), it may be derived
30 from past history (similar to the adaptive solution of the third embodiment) or it may be indicated by the SGSN 340 through the insertion of a mobility indication parameter in RANAP (radio access network application part) messages (e.g. common identity procedure which is always performed
35 for new Iu connection could be used). In case of, e.g., a

- 24 -

Serving RNC relocation, a mobility indication parameter is
sent to the Target RNC preferably inside the Source RNC To
Target RNC Transparent Container.

5   According to the fourth embodiment, the value of the
       periodic update timer value is added into the cell update
       confirm and URA Update confirm RRC message as an optional
       mobility information element. A MS receiving this periodic
       update timer value uses this timer value instead of the one
10   normally broadcast in common system information. Then RNC
       320 sets a long timer for static MS. The RNC may also adapt
       the release of the RRC connection to the mobility of the
       MS.

15   As described above, there is disclosed a method of
       adjusting mobility management in a mobile communication
       network, said mobile communication network comprising a
       mobility control unit 4; 40; 320 adapted to track location
       of communication units 1; 10; 310 communicating in said
20   mobile communication network and to control the mobility
       management for said communication units. Mobility
       information related to a communication unit is provided
       (S1) to said mobility control unit, which evaluates (S2)
       the degree of mobility of said communication unit from said
25   mobility information related to said communication unit. On
       the basis of said evaluated degree of mobility, mobility
       management elements used for mobility management of said
       communication unit in said mobile communication network are
       correspondingly adjusted (S3). Furthermore, there are
30   disclosed a corresponding mobility control unit, a
       corresponding communication unit as well as a corresponding
       mobility management adjustment system.

       While preferred embodiments and modifications thereof have
35   been described above, it is also possible to use

combinations of the embodiments in a further application. Also, the embodiments and the measures disclosed therein are not limited to be used in connection with the respective described network environment (2G, 3G), but can be easily modified in such that they are compatible with other network structures as those described in the embodiments.

It should be understood that the above description and accompanying figures are merely intended to illustrate the present invention by way of example only. The preferred embodiments of the present invention may thus vary within the scope of the attached claims.